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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/845,845	04/30/2001	Xia Sheng	10007799-1	3212

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EXAMINER
PHINNEY, JASON R

ART UNIT	PAPER NUMBER
2879	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/845,845	Applicant(s) SHENG ET AL.
	Examiner Jason Phinney	Art Unit 2879

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 March 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-39* is/are pending in the application.

4a) Of the above claim(s) *15-39* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 April 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4 and 5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-14, drawn to an electron emitter, classified in class 313, subclass 311.

II. Claims 15-39, drawn to the method of producing an electron emitter, classified in class 445, subclass 51.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by the materially different process of vapor deposition of layers without the need for anodizing the interface surface in hydrofluoric acid.

3. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

4. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

5. During a telephone conversation with Trueman Denny on 4/15/03 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-14. Affirmation of this election must be made by applicant in replying to this Office action. Claims 15-39 are

withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-3, 5-9, and 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,990,605 to Yoshikawa in view of U.S. Patent No 5,296,388 to Kameyama.

Regarding Claim 1, Yoshikawa discloses an electron emitter that comprises an electron injection layer (Figure 2, #12) including a front-side surface and a back-side surface; an active layer of high porosity porous silicon material (#13a) in contact with the front-side surface; a contact layer of low porosity porous silicon material (#13b) in contact with the active layer and including an interface surface. Yoshikawa fails to exemplify that there should be an n-type heavily doped region extending inward of the interface surface wherein the n-type heavily doped region is characterized by a low resistivity as claimed in Claim 1.

Regarding Claim 2, Yoshikawa further discloses that the electron injection layer should comprise an electrically conductive material selected from the group consisting of a n+ semiconductor, n+ single crystal silicon, an electrically conductive silicide, an electrically conductive nitride, a metal, and a layer of metal on a glass substrate (Column 5, Lines 59-62).

Regarding Claim 3, Yoshikawa further discloses that the n+ single crystal silicon should include a crystalline orientation selected from the group consisting of a 100 crystalline orientation and a 111 crystalline orientation (Column 6, Lines 13-17).

Regarding Claim 5, Yoshikawa further discloses that the back-side surface of the electron injection layer should include an ohmic contact (#11).

Regarding Claim 6, Yoshikawa further discloses that the ohmic contact should be made from a material selected from the group consisting of gold, a gold alloy, platinum, a platinum alloy, aluminum, an aluminum alloy, a multilayer of metal, tantalum on top of gold, and chromium on top of gold (Column 7, Lines56-57).

Regarding Claim 7, Yoshikawa further discloses that there should be a top electrode in contact with the interface surface (#15).

Regarding Claim 8, Yoshikawa further discloses that the top electrode should be made from an electrically conductive material selected from the group consisting of gold, a gold alloy, aluminum, an aluminum alloy, tungsten, a tungsten alloy, platinum, and a platinum alloy (Column 7, Lines 32-38).

Regarding Claim 9, Yoshikawa fails to exemplify that the contact layer of low porosity porous silicon material and the active layer of high porosity porous silicon material should be a material selected from the group consisting of porous epitaxial silicon, porous polysilicon, porous amorphous silicon, and porous silicon carbide.

Regarding Claim 12, Yoshikawa fails to exemplify that the porous polysilicon should be selected from the group consisting of n- porous polysilicon, p- porous polysilicon, and intrinsic porous polysilicon.

Regarding Claim 13, Yoshikawa fails to exemplify that for the n- porous polysilicon and the intrinsic porous polysilicon, the n-type heavily doped region of the contact layer includes a dopant material selected from the group consisting of arsenic, phosphorus, and antimony.

Kameyama in an alternate electron emitter teaches that there should be an n-type heavily doped region extending inward of the interface surface (Column 8, Lines 20-22) in order to improve the emissivity of the emitter. Kameyama also teaches that the contact layer and the active layer material should be selected from the group consisting of porous epitaxial silicon, porous polysilicon, porous amorphous silicon, and porous silicon carbide, wherein the porous polysilicon should be selected from the group consisting of n- porous polysilicon, p- porous polysilicon, and intrinsic porous polysilicon and for the n- porous polysilicon and the intrinsic porous polysilicon, the n-type heavily doped region of the contact layer includes a dopant material selected from the group consisting of arsenic, phosphorus, and antimony in order to improve the emissivity of the emitter (Figure 3 teaches of implanting ions of arsenic into the surface of porous poly-silicon #114 making it n-type).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to combine the n- porous poly-silicon layer with its surface embed with arsenic ions taught by Kameyama with the electron emitter of Yoshikawa in order to improve the emissivity.

8. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,990,605 to Yoshikawa in view of U.S. Patent No 5,296,388 to Kameyama and further in view of U.S. Patent No. 5,527,730 to Kayaoka.

Yoshikawa in view of Kameyama teaches the invention of Claims 1 and 2 as described above.

Yoshikawa in view of Kameyama fails to exemplify that the electrically conductive silicide should be selected from the group consisting of a titanium silicide and a platinum silicide, and the electrically conductive nitride should comprise a titanium nitride.

Kayaoka teaches that titanium silicide and titanium nitride are useful for their electron donative properties (Column 23, Lines 39-48).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to use the titanium nitride or titanium silicide taught by Kayaoka as the electron injection layer of Yoshikawa in view of Kameyama in order to take advantage of their superior electron donative properties.

9. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,990,605 to Yoshikawa in view of U.S. Patent No 5,296,388 to Kameyama and further in view of U.S. Patent No. 4,007,474 to Yagi.

Yoshikawa in view of Kameyama teaches the invention of Claims 1 and 9 as described above.

Regarding Claim 10, Yoshikawa in view of Kameyama fails to exemplify that the porous epitaxial silicon should be a material selected from the group consisting of n- porous epitaxial silicon, p- porous epitaxial silicon, and intrinsic porous epitaxial silicon.

Regarding Claim 11, Yoshikawa in view of Kameyama fails to exemplify that the n-type heavily doped region of the contact layer should include a dopant material selected from the group consisting of arsenic, phosphorus, and antimony.

Yagi teaches that n- porous epitaxial silicon doped with antimony has excellent electron emissive properties (Column 3, Lines 1-7 and Lines 16-21).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to use the n- porous epitaxial silicon doped with antimony taught by Yagi as the contact layer and the active layer of Yoshikawa in view of Kameyama in order to take advantage of their superior electron emissive properties.

10. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,990,605 to Yoshikawa in view of U.S. Patent No 5,296,388 to Kameyama and further in view of U.S. Patent No. 5,319,220 to Suzuki.

Yoshikawa in view of Kameyama teaches the invention of Claims 1 and 9 as described above.

Yoshikawa in view of Kameyama fails to exemplify that for the porous silicon carbide, the n-type heavily doped region of the contact layer should include a dopant material selected from the group consisting of nitrogen, phosphorus, and vanadium.

Suzuki teaches that for porous silicon carbide, the n-type heavily doped region of the contact layer can include a dopant material selected from the group consisting of nitrogen, phosphorus, and vanadium in order to effectively emit electrons (Column 4, Lines 12-18).

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to use the dopant material in the silicon carbide as taught by Suziki as the contact layer of Yoshikawa in view of Kameyama in order to effectively emit electrons.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason Phinney whose telephone number is (703) 305-3999. The examiner can normally be reached on M-F 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimesh Patel can be reached on (703) 305-4794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

JP
April 22, 2003

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